CLAIMS

We claim:

1. A multi-band antenna system comprising:

a main reflector having a shaped surface of revolution about a boresight axis of said antenna and being operable at a plurality of frequency bands spectrally offset from each other;

a multi-band feed system for said main reflector comprising a sub-reflector defining a second shaped surface of revolution about said boresight axis of said antenna and a plurality of feed horns decoupled from said sub-reflector;

a first one of said horns installed on said boresight axis at a first location separated by a first gap from a vertex of said sub-reflector, said first horn having a plurality of corrugations defining a profile extending from a throat of said first horn and along a tapered portion of said first horn, said profile shaped for producing a radiation pattern for illuminating said sub-reflector at a first frequency band; and

a second one of said horns installed coaxial within said first one of said horns and separated from said vertex on said boresight axis by a second gap, said second horn configured for producing a radiation pattern illuminating said sub-reflector on a second frequency band spectrally offset from said first frequency band.

2. The multi-band antenna system according to claim 1 wherein said profile is defined by the expression $r(z) = r_t + (r_a - r_t) * \left\{ (1-A)\frac{z}{L} + A\sin^2\left(\frac{z\pi}{2L}\right) \right\}$ where A is a constant that has a value of between about 0.4 and 0.6, r_a is the radius of the aperture of the first horn, r_t is the radius of the throat of the first horn, L is the overall length of the first horn, and z is the position relative to the throat of the first horn.

3. The multi-band antenna system according to claim 1 wherein said corrugations are disposed continuously along said throat and said tapered portion of said first horn.

4. The multi-band antenna system according to claim 1 further comprising an RF choke disposed on an exterior surface of said second feed horn at an aperture end thereof.

5. The multi-band antenna system according to claim 1 further comprising one or more phase compensating corrugations exclusive of said corrugations defining said profile, said phase compensating corrugations provided at an aperture of said first horn and defining a linear profile section parallel to a boresight axis of said antenna system.

6. The multi-band antenna system according to claim 5 wherein said phase compensating corrugations reposition a phase center of said first horn to substantially coincide with a phase center of said second horn.

7. The multi-band antenna system according to claim 1 further comprising a matching section formed from a plurality of said corrugations in the throat portion of said first horn.

8. The multi-band horn antenna system according to claim 7 wherein said corrugations of said matching section are comprised of a plurality of adjacent slots having differing depths, said depths tapering exponentially from a slot nearest a waveguide feed for said first horn to a slot at the portion of the matching section that is nearest an aperture of said first horn.

9. The multi-band horn antenna system according to claim 8 wherein said depths taper from about ½ wavelength for said slot at the portion of the throat nearest the waveguide feed, to about ¼ wavelength for said slot at the portion of the matching section that is nearest the aperture.

10. The multi-band antenna system according to claim 7 wherein a slot depth of said corrugations, exclusive of said corrugations forming said matching section, is less than 1/4 wavelength at a lowest operating frequency of said first horn.

11. The multi-band antenna system according to claim 1 wherein said second horn is an open-ended waveguide, exclusive of any taper along a length of said horn.

12. The multi-band antenna system according to claim 1 wherein a first distance between said vertex and an aperture of said first horn, as measured along said boresight axis, is substantially equal to a second distance between said vertex and an aperture of said second horn measured along said boresight axis.

13. The multi-band antenna system according to claim 1 wherein said first and second distances are each more than about four wavelengths at a lowest operating frequency of said first one of said frequency bands.

14. An antenna feed system, comprising:

a plurality of RF horn antennas for operating on a plurality of RF frequency bands;

a first one of said horns having a boresight axis and configured for operating at a first one of said frequency bands;

a second one of said horns positioned coaxially within said first horn, said second horn configured for operating at least at a second one of said frequency bands;

wherein said first horn is a corrugated horn having a plurality of corrugations formed on an interior surface, said corrugations defining a profile extending substantially from a throat of said first feed horn and along a tapered portion of said first feed horn.

15. The antenna feed system according to claim 14 wherein said profile has a curvature that substantially minimizes an interaction of said corrugations with said second horn.

16. The antenna feed system according to claim 14 wherein said profile is defined by the expression $r(z) = r_t + (r_a - r_t) * \left\{ (1-A)\frac{z}{L} + A\sin^2\left(\frac{z\pi}{2L}\right) \right\}$ where A is a constant that has a value of between about 0.4 and 0.6, r_a is the radius of the aperture of the first

horn, r_t is the radius of the throat of the first horn, L is the overall length of the first horn, and z is the position relative to the throat of the first horn.

17. The antenna feed system according to claim 14 wherein said corrugations extend continuously along said throat and said tapered portion of said first horn.

18. The antenna feed system according to claim 14 further comprising an RF choke disposed on an exterior surface of said second horn adjacent to an aperture of said second horn.

19. The antenna feed system according to claim 14 further comprising at least one phase compensating corrugation exclusive of said corrugations defining said profile, said phase compensating corrugation provided adjacent an aperture of said first horn and defining a linear profile section parallel to a boresight axis of said antenna system.

20. The multi-band antenna system according to claim 19 wherein said phase compensating corrugations control of a position of a phase center of said first horn to substantially coincide with a position of a phase center of said second horn.

21. The multi-band antenna system according to claim 14 further comprising a matching section formed from a plurality of said corrugations in the throat portion of said first horn.

22. The multi-band horn antenna system according to claim 21 wherein said corrugations of said matching section are comprised of a plurality of adjacent annular slots having differing depths, said depths tapering exponentially from a slot nearest a waveguide feed for said first horn to a slot at the portion of the matching section that is nearest an aperture of said first horn.

23. The multi-band horn antenna system according to claim 22 wherein said depths taper from about ½ wavelength for said slot at the portion of the throat nearest the waveguide feed, to about ¼ wavelength for said slot at the portion of the matching section that is nearest the aperture.

24. The multi-band antenna system according to claim 21 wherein a slot depth of said corrugations, exclusive of said corrugations forming said matching section, is less than 1/4 wavelength at a lowest operating frequency of said first horn.

25. The multi-band antenna system according to claim 14 wherein said second horn is an open-ended waveguide, exclusive of any taper along a length of said horn.

26. The antenna feed system according to claim 14 wherein an aperture of said second one of said feed horns is substantially aligned with an aperture of said first one of said feed horns.

27. An antenna feed system, comprising:

a plurality of RF horn antennas for operating on a plurality of RF frequency bands;

a first one of said horns having a boresight axis and configured for operating at a first one of said frequency bands;

a second one of said horns positioned coaxially within said first one of said horns along said boresight axis, said second horn configured for operating at least at a second one of said frequency bands;

wherein said first horn is a corrugated horn that has a plurality of corrugations formed on an interior surface, said corrugations extending substantially continuously along a throat portion of said first horn and a tapered portion of said first horn to define a profile, said profile substantially minimizing an interaction of said corrugations with said second horn.

28. The multi-band antenna system according to claim 27 further comprising a matching section formed from a plurality of said corrugations in the throat portion of said first horn.

29. The multi-band horn antenna system according to claim 28 wherein said corrugations of said matching section are comprised of a plurality of adjacent annular slots having differing depths, said depths tapering exponentially from a slot of said

matching section nearest a waveguide feed for said first horn to a slot at the portion of the matching section that is nearest an aperture of said first horn.

30. The multi-band horn antenna system according to claim 29 wherein said depths taper from about ½ wavelength for said slot at the portion of the throat nearest the waveguide feed, to about ¼ wavelength for said slot at the portion of the matching section that is nearest the aperture.

31. The multi-band antenna system according to claim 28 wherein a slot depth of said corrugations, exclusive of said corrugations forming said matching section, is less than 1/4 wavelength at a lowest operating frequency of said first horn.

32. The multi-band antenna system according to claim 31 wherein said second horn is an open-ended waveguide, exclusive of any taper along a length of said horn.

33. The antenna feed system according to claim 31 further comprising an RF choke disposed on an exterior surface of said second feed horn adjacent to an aperture of said second horn.

34. The antenna feed system according to claim 31 wherein an aperture of said second one of said horns is substantially aligned with an aperture of said first one of said feed horns.

35. The antenna feed system according to claim 31 further comprising a plurality of phase compensating corrugations exclusive of said corrugations defining said profile, said phase compensating corrugations provided at said aperture of said first horn and defining a linear profile section parallel to said boresight axis.

36. The antenna feed system according to claim 31 further comprising a sub-reflector defining a shaped surface of revolution about said boresight axis and spaced from said aperture of said first horn and said aperture of said second horn by a first and second distance, respectively, so that said sub-reflector is substantially de-coupled from each of said first horn and said second horn.

37. The antenna feed system according to claim 36 wherein said first and second distance are substantially equal

38. The antenna feed system according to claim 31 wherein said profile is defined by the expression $r(z) = r_t + (r_a - r_t) * \left\{ (1 - A)\frac{z}{L} + A\sin^2\left(\frac{z\pi}{2L}\right) \right\}$ where A is a constant that has a value of between about 0.4 and 0.6, r_a is the radius of the aperture of the first horn, r_t is the radius of the throat of the first horn, L is the overall length of the first horn, and z is the position relative to the throat of the first horn.